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NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

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Vereenigde
Nieuwe Parklaan 97
NL-2587 BN The Hague
PAYS-BAS

Date of mailing (day/month/year)
20 February 2001 (20.02.01)

Applicant's or agent's file reference
P10502PC00

IMPORTANT NOTIFICATION

International application No.
PCT/NL99/00562

International filing date (day/month/year)
10 September 1999 (10.09.99)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

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Date of mailing (day/month/year) 29 May 2000 (29.05.00)	
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Applicant VAN DE BERG, Jan et al	

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(57) Abstract

The system comprises at least one electronic sensor for detecting the presence of moisture. The system further comprises at least one reading device for obtaining information from the sensor about the presence of moisture. The sensor comprises a resonant circuit which is at least partly formed from a moisture sensitive material, the electrical resistance of which increases when the material comes into contact with moisture. The reading device comprises transmitter-receiver means for generating an electromagnetic interrogation field.

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Title: A system for detecting the presence of moisture.

The invention relates to a system for detecting the presence of moisture, comprising at least one electronic sensor for detecting the presence of moisture and at least one reading device for obtaining information from the at least one sensor about the presence of moisture.

Such a system is known per se. In the known system the electronic sensor often comprises two electrodes, a short circuit between the electrodes owing to the presence of moisture being detected by an electronic circuit of the sensor. By means of the reading device it is then established that in the sensor the above short circuit occurs between the two electrodes, and that moisture is therefore present at the sensor.

It is a drawback of the known system that the information generated by the sensor about the presence of moisture is often not sufficiently reliable. Moreover, such an electronic sensor is rather expensive and thus less suitable for use as a disposable sensor.

The invention has for its object, inter alia, to meet the above drawbacks and, furthermore, to provide a number of advantages.

The system according to the invention is accordingly characterized in that the at least one sensor comprises a resonant circuit which is at least partly formed from a moisture sensitive material, the electrical resistance of which increases when the material comes into contact with moisture, the reading device comprising transmitter-receiver means for generating an electromagnetic interrogation field comprising at least one frequency component corresponding to a resonance frequency of the resonant circuit, the at least one sensor, in use, being brought into the electromagnetic interrogation field, the reading device recording the response of the at least one sensor to the electromagnetic interrogation field to obtain information about the presence of moisture at the at least one sensor.

It has been found that the effect of moisture on the moisture sensitive material and thus the presence of moisture at the sensor can be recorded very sensitively and accurately. When the moisture sensitive material comes into contact with moisture, the electrical resistance will increase. Because of the increase in the electrical resistance, the electrical properties of the resonant circuit will change and the response of the resonant circuit to the interrogation field will thereby also change. In this connection it is even conceivable that in this manner not only the presence of moisture at the sensor is detected, but that even an impression can be obtained of the amount of moisture present at the sensor.

The sensor according to the invention can be used, inter alia, in baby diapers, incontinence diapers, sanitary towels, incubators, packages for vegetables and fruit, on the road surface for detection of rain and at a substratum in the cultivation under glass. It is also possible to use the sensor in drying processes, such as, for instance, in the paper industry.

Preferably, it applies that the moisture sensitive material is included in the resonant circuit in such a manner that the Q factor of the resonant circuit decreases when the resistance of the moisture sensitive material increases. The Q factor of the intact dry sensor is therefore high. This means that the sensor can be properly detected in this condition. The system can therefore also be used to check whether a sensor is present in the product (such as, for instance, a diaper). This possibility is not present at the above prior art sensor, because this sensor does not react when no short circuit is present between the two electrodes.

A further advantage is that the change in the characteristic of the sensor is reversible. When the sensor dries again, the resistance of the moisture sensitive material will decrease.

In the above special embodiment this means that the Q factor of the resonant circuit increases again.

According to a special embodiment it applies that the resonant circuit at least comprises an LC circuit. In this connection the entire LC circuit or at least part of the LC circuit may be built up from the moisture sensitive material.

In particular, it applies that the moisture sensitive material comprises a binding agent capable of swelling in moisture, in which binding agent electrically conductive particles are included. It is also possible that the moisture sensitive material comprises a binding agent in which particles capable of swelling in moisture and electrically conductive particles are included. In both cases moisture ensures a swelling of respectively the binding agent and the particles capable of swelling. Consequently, the electrically conductive particles will be drawn apart and the conductivity of the moisture sensitive material will decrease so that the electrical resistance of the material increases.

In particular, it applies that the reading device generates an alarm signal when moisture is detected by means of the sensor.

According to a very advanced embodiment of the invention the system is also designed as an identification system in which the at least one sensor comprises an active electronic circuit connected with the resonant circuit, such as a microprocessor in which an identification code is stored, which identification code is passed to the resonant circuit when the resonant circuit is resonated by the electromagnetic interrogation field, and the reading device being arranged to read the identification code by means of the electromagnetic interrogation field.

This system can, for instance, advantageously be used in a hospital, the sensor being used to record moisture in a mattress of a hospital bed. Each sensor may then comprise an identification code belonging to a specific hospital bed. In

this manner it is not only possible to record that a mattress has become wet, but also which mattress has become wet.

The system may further comprise a central control unit which is, optionally wirelessly, connected with the at least one reading device for obtaining information about the presence of moisture at the at least one sensor.

In the example of the above hospital the central control unit can be installed, for instance, in the room of a nurse. The reading devices can be installed in the different rooms of the patients. In this manner it can be centrally recorded in which room which bed has got a wet mattress.

The invention will now be explained in more detail with reference to the drawing, in which:

Fig. 1 shows a possible embodiment of a system for detecting the presence of moisture according to the invention;

Fig. 2 shows the transfer characteristic of a resonant circuit of a sensor of the system of Fig. 1;

Fig. 3 shows a first alternative embodiment of a sensor of the system of Fig. 1;

Fig. 4a shows a second alternative embodiment of a sensor of the system of Fig. 1;

Fig. 4b shows an electrical equivalent circuit diagram of the sensor of Fig. 4a;

Fig. 5a diagrammatically shows a relatively dry condition of the moisture sensitive material of one of the sensors of Figs. 1, 3, 4a and 4b; and

Fig. 5b shows the moisture sensitive material of Fig. 5a, when this is relatively moist.

In Fig. 1 a system for detecting the presence of moisture is indicated by reference numeral 1. The system comprises a number of electronic sensors 2.i ($i = 1, 2, \ldots, n$) for detecting the presence of moisture. The system further comprises at least one reading device 4.1 for obtaining information from the sensors 2.i about the presence of moisture.

Each of the sensors 2.i comprises a resonant circuit 6 shown in dotted lines, which is at least partly formed from a moisture sensitive material 8. In this example the resonant circuit comprises an LC circuit 10, 12, in which the moisture sensitive material 8 is included. The moisture sensitive material is of a type of which the electrical resistance increases when the material comes into contact with moisture.

The reading device 4.1 comprises transmitting and receiving means 14 for generating an electromagnetic interrogation field. The electromagnetic interrogation field comprises at least one frequency component which corresponds to a resonance frequency of the resonant circuit 6. In this example the resonant circuit has only one resonance frequency f_0. The electromagnetic interrogation field then also has one frequency f_0. It is explicitly observed that it is also possible that the electromagnetic interrogation field comprises more frequencies, for instance, because it can be shifted in frequency.

The operation of the apparatus is as follows. To check whether moisture is present at the sensor 2.i, the electromagnetic interrogation field is transmitted by means of transmitter-receiver unit 14 at the frequency f_0. When the sensor is not moist, this means that the resistance of the moisture sensitive material 8 is low. This means that the Q factor of the LC circuit is high. When the resonant circuit is therefore brought into the interrogation field, the resonant circuit will start to resonate and therefore to vibrate at the frequency f_0. By means of the transmitter-receiver unit 14 it is recorded that the resonant circuit 6 is in vibration. The information about the presence of moisture at sensor 2.i thus wirelessly obtained by the transmitter-receiver unit 14 is passed via line 16 of the reading device 4.1 to a signal processing unit 18 of the reading device.

The signal processing unit 18 may, for instance, comprise a threshold circuit to determine whether the

response of the resonant circuit 6 is above or below a specific value. Is the response above this specific value, then it can be concluded that the sensor is dry, and is the response below this predetermined value, then it can be concluded that the sensor is wet. In that case an alarm signal can be generated by the signal processing unit 18 in a known per se manner.

The moisture sensitive material 8 can be applied in different manners. Thus, for instance, the sensor 2.i can be composed of a sheet-like carrier material 20, layers of conductive material forming the resonant circuit 6 being applied by known per se techniques. In this example this resonant circuit comprises, inter alia, a coil 10 and a capacitor 12. The coil 10 and the capacitor 12 can each be made of, for instance, copper. The moisture sensitive material 8 can be arranged on the carrier material 20 as a separate resistor. Both the coil 10 and the capacitor 12 and the moisture sensitive resistor 8 are arranged in the form of traces.

It is also possible that the material of the LC circuit itself is made of moisture sensitive material. Such a resonant circuit is shown in Fig. 4a. In Fig. 4a at least part of the coil 10 and/or the capacitor 12 is therefore made of the moisture sensitive material.

Fig. 4b shows the electrical equivalent circuit diagram thereof, which therefore corresponds to the diagram of the sensor shown in Fig. 1.

The realization of the moisture dependent conductivity of the moisture sensitive material can be obtained, for instance, by mixing electrically conductive particles D, preferably silver-containing, with a binding agent B capable of swelling in water, in such a manner that the particles D make a continuous contact, that is to say that the concentration of the particles rises above the percolation limit (see also Fig. 5a). The layer thickness of the thus formed conductive coating 8 can be of the order of

what, for instance, can be applied with screen printing (10-500 µm). By contact with water the binding agent B will swell so that the electrically conductive particles are driven apart and the continuous contact is broken. That is to say that the concentration of the particles D falls below the percolation limit (see Fig. 5b).

Instead of a binding agent capable of swelling in water, particles capable of swelling in water can also be used in combination with the electrically conductive particles, while the employed binding agent itself need not be capable of swelling in water, but is water-sensitive to a greater or less degree. The nature and concentration of the particles capable of swelling as well as the nature and concentration of the binding agent are parameters adapted to adjust the velocity and degree of swelling. A specific characteristic of the material with respect to moisture can thus be obtained. Two examples of recipes for water-sensitive electrically conductive materials are:

Example 1:

Stabileze (0.5% in water)	50
water	10
glycerine (10% in water)	1.25
metalite silver SF 20	2.5
NaOH (10% in water)	0.25

layer thickness wet:	500 µm
layer thickness dry:	100 µm
response time:	< 1 s

Example 2:

PA 18 polyanhydride resin (40% in MEK)	1.00
Stabileze (activated in NH_3), particles < 60 µm	0.25

glycerine (20% in butanol)	1.00
metalite silver SF 20	1.50
MEK/butanol (1/1)	2.00

layer thickness wet:	300 µm
layer thickness dry:	170 µm
response time:	ca. 45 s

As conductive particles different material types and forms of can be chosen. Examples are metals such as silver, copper, rvs, aluminum and zinc in forms like granules, fibers, flakes, globules etc. Also materials such as soot, graphite or intrinsically conductive polymer particles can be used in principle.

By properly composing the moisture sensitive coating material the moisture sensor can be made with standard coating and printing techniques like screen printing, ball printing, roller coating, spray coating etc.

As stated, the moisture sensitive material 8 can be included in the resonant circuit in such a manner that the Q factor of the resonant circuit decreases when the resistance of the moisture sensitive material increases.

In Fig. 2 curve A indicates the transfer function H of the resonant circuit 6 when the moisture sensitive material is dry, that is to say when the Q factor is high. Then B indicates the curve obtained when the moisture sensitive material is wet, which has the result that the Q factor decreases.

The transmitter-receiver means 14 can be designed as a transmission system for detecting an electromagnetic response signal generated by the sensor 2.i, in response to the electromagnetic interrogation field. In fact, when the resonant circuit is vibrated by the electromagnetic interrogation field, it will therefore transmit an electromagnetic response signal which can in turn be detected by the transmitter-receiver means 14. This is referred to as

a known per se transmission system. The signal processing device 18 can determine by means of the intensity of the detected response signal to what extent the sensor 2.i is in contact with moisture. For the above sensor, to which it applies that the Q factor decreases when the sensor comes into contact with water, the signal processing device 18 may comprise a threshold circuit to determine whether the detected intensity is below a predetermined value. Is it actually below a predetermined value, then it can be concluded that the sensor 2.i is wet and, if desired, an alarm signal can be produced.

It is also possible, however, that the transmitter-receiver unit is designed as a known per se absorption system. When the resonant circuit 6 is vibrated by the electromagnetic interrogation field, this energy will absorb from the electromagnetic interrogation field. This energy absorption can be detected in the transmitter-receiver unit 14 in a known per se manner. When the sensor is dry and therefore has a high Q factor, much energy will be taken up from the interrogation field. On the other hand, when the sensor is moist, little or no energy will be taken up from the interrogation field.

Via line 16 information can again be supplied to the signal processing device 18 in the form of the amount of energy taken up from the electromagnetic interrogation field. The reading device 41 can then determine on the basis of the amount of energy absorbed by the at least one sensor to what extent the at least one sensor is in contact with moisture. In particular, it applies again that the signal processing device 18 comprises a threshold circuit to determine whether the amount of energy taken up is below a predetermined value.

Preferably, it applies that each sensor 2.i further comprises an active electronic circuit, such as a microprocessor 22 in which an identification code belonging to the sensor 2.i is stored. The microprocessor is connected with the resonant circuit 6. When the resonant circuit is in

the interrogation field, a part of the currents generated in the resonant circuit can be rectified by means of, for instance, a diode 23 and supplied to the microprocessor 22. In reaction to this, the microprocessor will supply the stored identification codes to the resonant circuit. The response signal generated in the resonant circuit in response to the electromagnetic interrogation field is then modulated by means of the identification code. This identification code can be detected by the transmitter-receiver unit 14 and supplied to the signal processing unit 18. The signal processing unit 18 can then determine from which sensor 2.i a response has been detected. Such a system is highly important when it comprises, as in the present example, a plurality of sensors 2.i. When at a given moment the response of one or more sensors falls away, because the sensor in question comes into contact with moisture, it can be established by means of the reading device 4.1 which identification code is no longer received and, therefore, which sensor is in contact with moisture.

Such a system can advantageously be used in a hospital in which each mattress comprises a sensor 2.i. When one of the mattresses then becomes moist, this can be detected by means of the reading device 4.1, and moreover, it can be established which sensor and, therefore, which mattress is concerned. The nurse can then start changing the patient, if required.

The system can further be extended with a central control unit 24 and a plurality of reading devices 4.i ($i = 1, 2, \ldots, m$). Each reading device 4.i is optionally wirelessly connected with the central control unit 24 to obtain information about the presence of moisture at one of the sensors 2.i. In use, a reading device 4.i can be installed, for instance, in each room of a hospital. Furthermore, a number of beds with mattresses are installed in each room, each of which mattresses comprises a sensor 2.i with a specific identification code. When one of the

mattresses in the rooms becomes moist, an alarm signal can thus be generated at the central control unit 24, so that a nurse can immediately establish which sensor has come into contact with moisture.

The invention is by no means limited to the above embodiments. Thus, for instance, the moisture sensitive material 8 can also be included in the resonant circuit in such a manner that the Q factor of the resonant circuit increases when the resistance of the moisture sensitive material increases. An example thereof is shown in Fig. 3. In this example the moisture sensitive material 8 is parallel-connected to the LC circuit 10, 12 in the form of a resistor. When the sensor of Fig. 3 is dry, the resistance of the moisture sensitive material 8 will be low and thus in fact cause a short circuit in the LC circuit 10, 12. This means that the sensor of Fig. 3 will hardly, if at all, react to the interrogation field when the sensor is dry. On the other hand, when the sensor comes into contact with moisture, the resistance of the moisture sensitive material will increase and the short circuit will gradually be removed. This has the result that in this case the LC circuit will react when brought into the above interrogation field. This reaction can then be detected by means of the reading device, both when the reading device is designed as a transmission system and as an absorption system. When, therefore, an electromagnetic response signal is received, when it is detected that energy is taken up from the electric interrogation field, it can be concluded that the sensor in question is wet.

In the example of Fig. 3 the sensor again comprises the microprocessor discussed before. When the sensor of Fig. 3 reacts, the identification code can then also be sent directly to the transmitter-receiver device, so that by means of the reading device it can be directly establish which sensor reacts, in other words which sensor is wet. The transfer of the resonant circuit of Fig. 3 is therefore such that curve A of Fig. 2 is applicable when the sensor is wet

and curve B when the sensor is dry. It is also conceivable that each sensor 2.i comprises a resonant circuit with a unique resonance frequent f_i, with $f_i \neq t_j$ if $i \neq j$. By emitting an interrogation field, the frequency of which increases in a previously known manner, it can be detected whether a sensor 2.i is moist, while at the same time the frequency f_i and thus the identity of a sensor can be established.

It is further also conceivable that other principles are used, so that the electrical resistance of the material of the LC circuit is changed. By way of example, it can be mentioned that the electrical resistance of the intrinsically conductive polymers, such as polyaniline, polypyrrole or polythiophene, changes under the influence of water in which salts or ions are included. In that case, in particular for instance, urine can be detected. It is explicitly mentioned that in each of the embodiments the microprocessor can be left out.

Such variants are each deemed to fall within the scope of the invention.

Claims

1. A system for detecting the presence of moisture, comprising at least one electronic sensor for detecting the presence of moisture and at least one reading device for obtaining information from the at least one sensor about the presence of moisture, characterized in that the at least one sensor comprises a resonant circuit which is at least partly formed from a moisture sensitive material, the electrical resistance of which increases when the material comes into contact with moisture, the reading device comprising transmitter-receiver means for generating an electromagnetic interrogation field comprising at least one frequency component corresponding to a resonance frequency of the resonant circuit, the at least one sensor, in use, being brought into the electromagnetic interrogation field, the reading device recording the response of the at least one sensor to the electromagnetic interrogation field to obtain information about the presence of moisture at the at least one sensor.

2. A system according to claim 1, characterized in that the moisture sensitive material is included in the resonant circuit in such a manner that the Q factor of the resonant circuit decreases when the resistance of the moisture sensitive material increases.

3. A system according to claim 1, characterized in that the moisture sensitive material is included in the resonant circuit in such a manner that the Q factor of the resonant circuit increases when the resistance of the moisture sensitive material increases.

4. A system according to any of the preceding claims, characterized in that the resonant circuit at least comprises an LC circuit.

5. A system according to claim 4, characterized in that the entire LC circuit or at least part of the LC circuit is built up from the moisture sensitive material.

6. A system according to any of the preceding claims, characterized in that the moisture sensitive material comprises a binding agent capable of swelling in moisture, in which binding agent electrically conductive particles are included.

7. A system according to any of the preceding claims, characterized in that the moisture sensitive material comprises a binding agent in which particles capable of swelling in moisture and electrically conductive particles are included.

8. A system according to any of the preceding claims, characterized in that the moisture sensitive material is arranged on a carrier material in the form of a coating.

9. A system according to claims 4 and 8, characterized in that at least part of the LC circuit is formed by the coating.

10. A system according to any of the preceding claims, characterized in that the transmitter-receiver means are designed as a transmission system for detecting an electromagnetic response signal generated by the at least one sensor, in response to the electromagnetic interrogation field.

11. A system according to claim 10, characterized in that, in use, the reading device determines on the basis of the intensity of the detected response signal to what extent the at least one sensor is in contact with moisture.

12. A system according to claims 2 and 11, characterized in that the reading device comprises a threshold circuit to determine whether the detected intensity is below a predetermined value.

13. A system according to any of claims 1-9, characterized in that the transmitter-receiver means are designed as an absorption system for detecting energy taken

up from the interrogation field by the at least one sensor in response to the electromagnetic interrogation field.

14. A system according to claim 13, characterized in that, in use, the reading device determines on the basis of the amount of energy absorbed by the at least one sensor to what extent the at least one sensor is in contact with moisture.

15. A system according to claims 2 and 13, characterized in that the reading device comprises a threshold circuit to determine whether the amount of energy absorbed is below a predetermined value.

16. A system according to any of the preceding claims, characterized in that the reading device generates an alarm signal when moisture is detected by means of the at least one sensor.

17. A system according to any of the preceding claims, characterized in that the system is also designed as an identification system in which the at least one sensor comprises a microprocessor connected with the resonant circuit, in which microprocessor an identification code is stored, which identification code is passed to the resonant circuit when the resonant circuit is resonated by the electromagnetic interrogation field, and the reading device being arranged to read the identification code by means of the electromagnetic interrogation field.

18. A system according to any of the preceding claims, characterized in that the system further comprises a central control unit which is, optionally wirelessly, connected with the at least one reading device for obtaining information about the presence of moisture at the at least one sensor.

19. A sensor of the system according to any of the preceding claims.

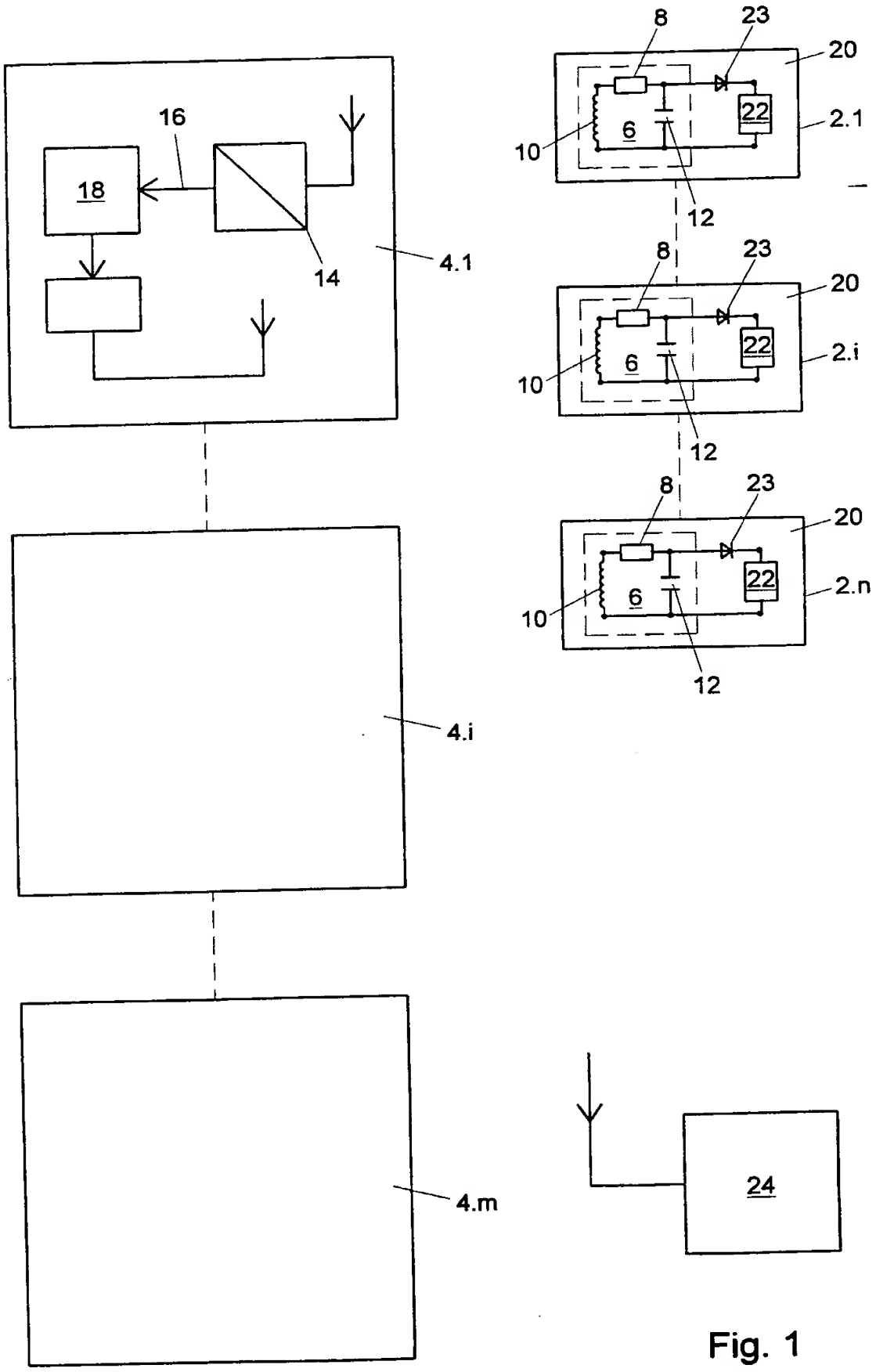

Fig. 1

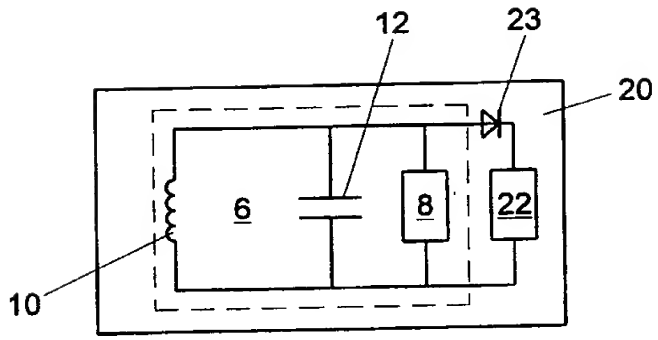

Fig. 3

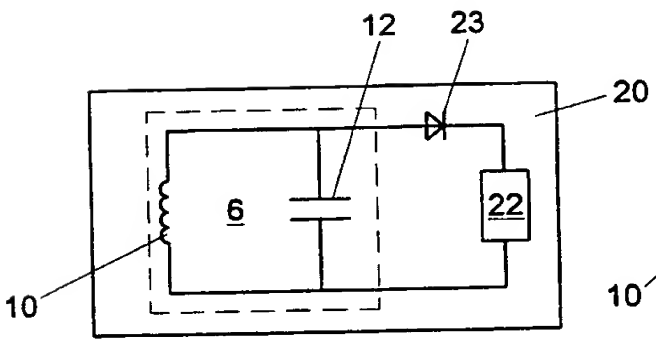

Fig. 4A

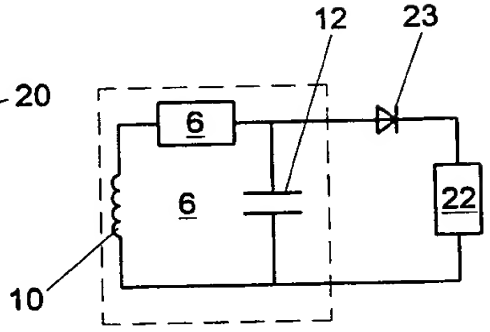

Fig. 4B

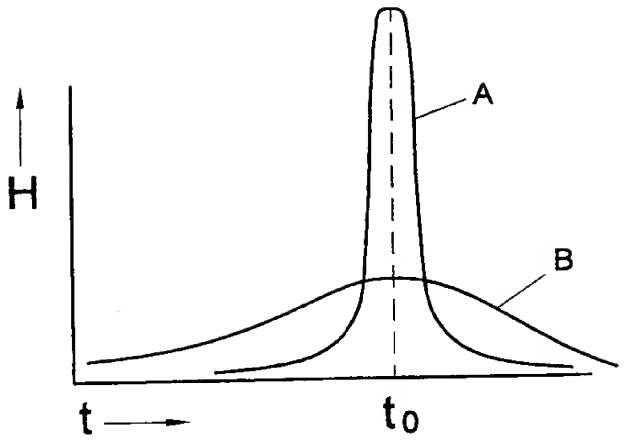

Fig. 2

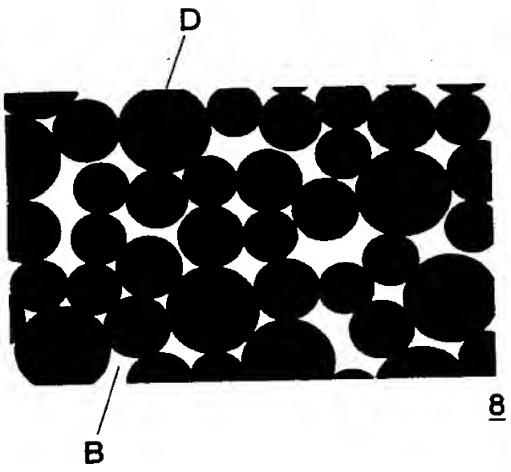

Fig. 5A

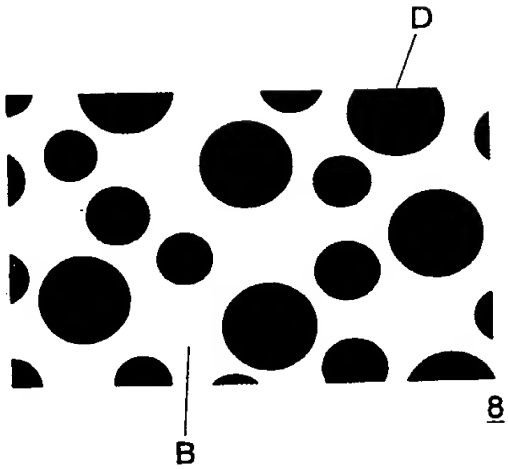

Fig. 5B

INTERNATIONAL SEARCH REPORT

In nal Application No
PCT/NL 99/00562

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01N27/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 40 30 284 A (BRANDES GMBH) 17 June 1992 (1992-06-17) abstract ---	1,19
Y	GB 2 192 059 A (ELECTRICITY COUNCIL) 31 December 1987 (1987-12-31) abstract ---	1,19
A	EP 0 329 436 A (ASAHI CHEMICAL IND) 23 August 1989 (1989-08-23) claims 1-4 ---	1
A	US 3 686 606 A (THOMA PAUL E) 22 August 1972 (1972-08-22) abstract --- -/--	1

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 January 2000	12/01/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Duchatellier, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

tional Application No
PCT/NL 99/00562

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 84 01626 A (BERGVELD PIET) 26 April 1984 (1984-04-26) abstract	1
A	US 4 646 069 A (ANDREJASICH RAYMOND J ET AL) 24 February 1987 (1987-02-24) abstract	1
A	GB 2 245 976 A (HUTTON GEOFFREY HEWLAND ;ROSTRON ROBERT MICHAEL (GB)) 15 January 1992 (1992-01-15) claim 14	1
A	DE 26 55 271 A (BIELER U LANG OHG AUTOMATION S) 8 June 1978 (1978-06-08) claim 1; figure 1	1

1

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No
PCT/NL 99/00562

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
DE 4030284	A	17-06-1992	NONE		
GB 2192059	A	31-12-1987	NONE		
EP 0329436	A	23-08-1989	CA	1306525 A	18-08-1992
			JP	2049149 A	19-02-1990
			JP	2812475 B	22-10-1998
			US	4942364 A	17-07-1990
US 3686606	A	22-08-1972	CA	935522 A	16-10-1973
			GB	1298297 A	29-11-1972
WO 8401626	A	26-04-1984	NL	8203901 A	01-05-1984
			EP	0121544 A	17-10-1984
US 4646069	A	24-02-1987	NONE		
GB 2245976	A	15-01-1992	NONE		
DE 2655271	A	08-06-1978	NONE		

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No
PCT/NL 99/00562

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4030284 A	17-06-1992	NONE	
GB 2192059 A	31-12-1987	NONE	
EP 0329436 A	23-08-1989	CA 1306525 A	18-08-1992
		JP 2049149 A	19-02-1990
		JP 2812475 B	22-10-1998
		US 4942364 A	17-07-1990
US 3686606 A	22-08-1972	CA 935522 A	16-10-1973
		GB 1298297 A	29-11-1972
WO 8401626 A	26-04-1984	NL 8203901 A	01-05-1984
		EP 0121544 A	17-10-1984
US 4646069 A	24-02-1987	NONE	
GB 2245976 A	15-01-1992	NONE	
DE 2655271 A	08-06-1978	NONE	

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

RECORD COPY

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PCT/NL 99 / 0 05 62
International Application No.

10 SEP 1999 (10.09.99)
International Filing Date

BUREAU VOOR DE INDUSTRIELE EIGENDOM
P.C.T. INTERNATIONAL APPLICATION

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum) P10502PC00

Box No. I TITLE OF INVENTION

System for detecting the presence of moisture

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

Nederlandse Organisatie voor toegepast- natuurwetenschappelijk
Onderzoek TNO
Schoemakerstraat 97
2628 VK Delft
the Netherlands

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State *(that is, country)* of nationality: NL

State *(that is, country)* of residence: NL

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

van de Berg, Jan
Bloklandpolderstraat 15
2807 LH Gouda
the Netherlands

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is,country)* of nationality: NL

State *(that is, country)* of residence: NL

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

Mr Drs S.U. Ottevangers, c.s.
c/o VEREENIGDE OCTROOIBUREAUX
Nieuwe Parklaan 97
2587 BN The Hague
the Netherlands

Telephone No.
070 - 4166711

Facsimile No.
070 - 4166799

Teleprinter No.

☐ **Adress for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

de Haan, Peter Hillebrand
Hof van Delftlaan 118
2613 BS Delft
the Netherlands

This person is:
- [ ] applicant only
- [x] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: NL

State *(that is, country)* of residence: NL

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [x] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

- [ ] Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

- ☒ **AP** **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SL Sierra Leone, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ **EA** **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ **EP** **European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ **OA** **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- ☒ **AE** United Arab Emirates
- ☒ **AL** Albania
- ☒ **AM** Armenia
- ☒ **AT** Austria
- ☒ **AU** Australia
- ☒ **AZ** Azerbaijan
- ☒ **BA** Bosnia and Herzegovina
- ☒ **BB** Barbados
- ☒ **BG** Bulgaria
- ☒ **BR** Brazil
- ☒ **BY** Belarus
- ☒ **CA** Canada
- ☒ **CH and LI** Switzerland and Liechtenstein
- ☒ **CN** China
- ☒ **CU** Cuba
- ☒ **CZ** Czech Republic
- ☒ **DE** Germany
- ☒ **DK** Denmark
- ☒ **EE** Estonia
- ☒ **ES** Spain
- ☒ **FI** Finland
- ☒ **GB** United Kingdom
- ☒ **GD** Grenada
- ☒ **GE** Georgia
- ☒ **GH** Ghana
- ☒ **GM** Gambia
- ☒ **HR** Croatia
- ☒ **HU** Hungary
- ☒ **ID** Indonesia
- ☒ **IL** Israel
- ☒ **IN** India
- ☒ **IS** Iceland
- ☒ **JP** Japan
- ☒ **KE** Kenya
- ☒ **KG** Kyrgyzstan
- ☒ **KP** Democratic People's Republic of Korea
- ☒ **KR** Republic of Korea
- ☒ **KZ** Kazakhstan
- ☒ **LC** Saint Lucia
- ☒ **LK** Sri Lanka
- ☒ **LR** Liberia
- ☒ **LS** Lesotho
- ☒ **LT** Lithuania
- ☒ **LU** Luxembourg
- ☒ **LV** Latvia
- ☒ **MD** Republic of Moldova
- ☒ **MG** Madagascar
- ☒ **MK** The former Yugoslav Republic of Macedonia
- ☒ **MN** Mongolia
- ☒ **MW** Malawi
- ☒ **MX** Mexico
- ☒ **NO** Norway
- ☒ **NZ** New Zealand
- ☒ **PL** Poland
- ☒ **PT** Portugal
- ☒ **RO** Romania
- ☒ **RU** Russian Federation
- ☒ **SD** Sudan
- ☒ **SE** Sweden
- ☒ **SG** Singapore
- ☒ **SI** Slovenia
- ☒ **SK** Slovakia
- ☒ **SL** Sierra Leone
- ☒ **TJ** Tajikistan
- ☒ **TM** Turkmenistan
- ☒ **TR** Turkey
- ☒ **TT** Trinidad and Tobago
- ☒ **UA** Ukraine
- ☒ **UG** Uganda
- ☒ **US** United States of America
- ☒ **UZ** Uzbekistan
- ☒ **VN** Viet Nam
- ☒ **YU** Yugoslavia
- ☒ **ZA** South Africa
- ☒ **ZW** Zimbabwe

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

- ☒ CR Costa Rica
- ☒ DM Dominica

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application: receiving Office
item (1) 11 September 1998 (11.09.98)	1010067	NL		
item (2)				
item (3)				

☐ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s) _____

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*	**Request to use results of earlier search; reference to that search** *(if an earlier search has been carried out by or requested from the International Searching Authority):*		
	Date *(day/month/year)*	Number	Country *(or regional Office)*
ISA / EP	4 June 1999	SN 31834 NL	EP

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following **number of sheets**:

request	: 4
description (excluding sequence listing part)	: 13
claims	: 4
abstract	: 1
drawings	: 3
sequence listing part of description	:
Total number of sheets	: 25

This international application is **accompanied by** the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological materia
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*:

Figure of the drawings which should accompany the abstract:

Language of filing of the international application: Dutch

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

W.E.M. ten Cate

For receiving Office use only

1. Date of actual receipt of the purported international application:	10 SEP 1999 (10.09.99)	2. Drawings: ☒ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:		
4. Date of timely receipt of the required corrections under PCT Article 11(2):		
5. International Searching Authority (if two or more are competent): ISA /	6. ☐ Transmittal of search copy delayed until search fee is paid.	

For International Bureau use only

Date of receipt of the record copy by the International Bureau: 30 SEPTEMBER 1999 (30.09.99)

PCT/NL 99/00562

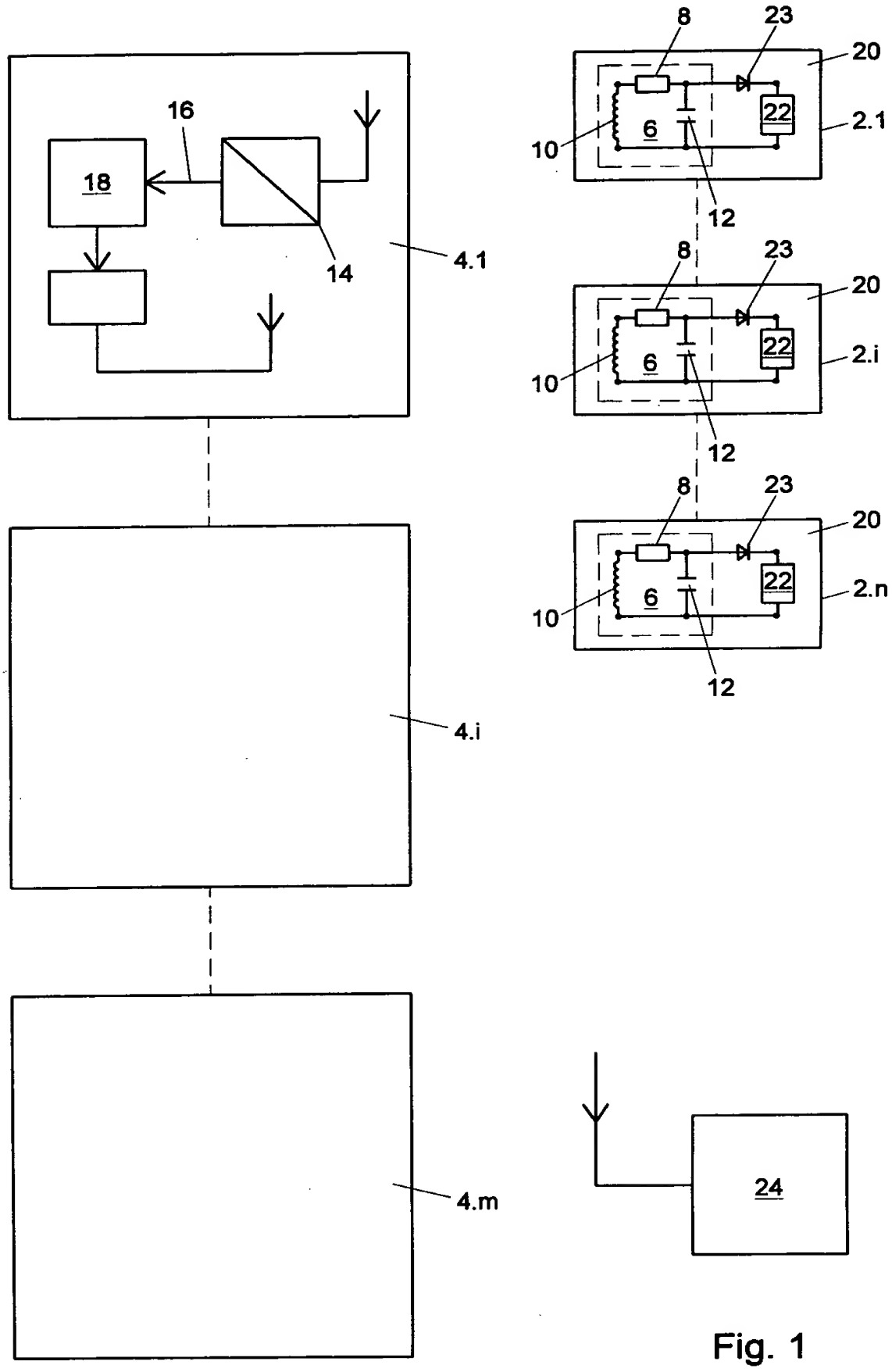

Fig. 1

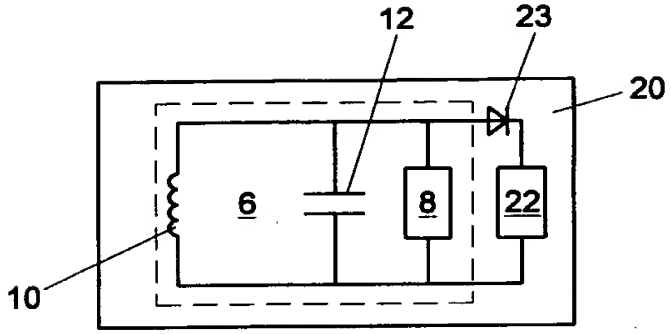

Fig. 3

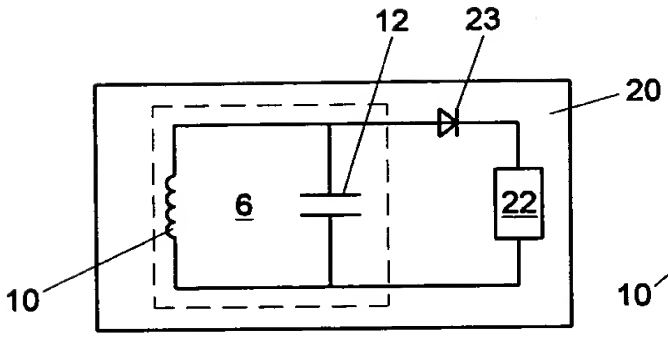

Fig. 4A

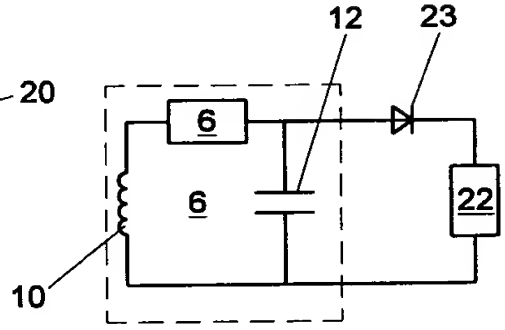

Fig. 4B

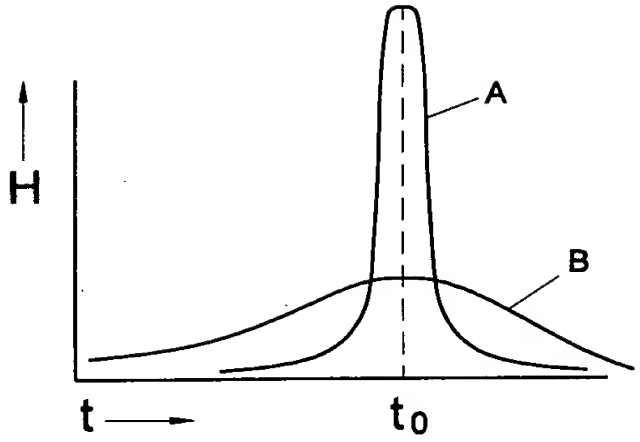

Fig. 2

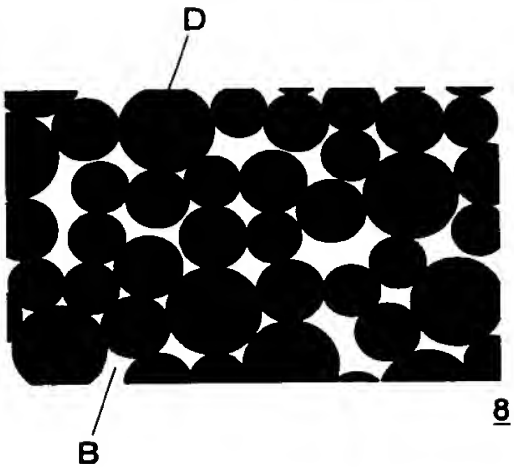

Fig. 5A

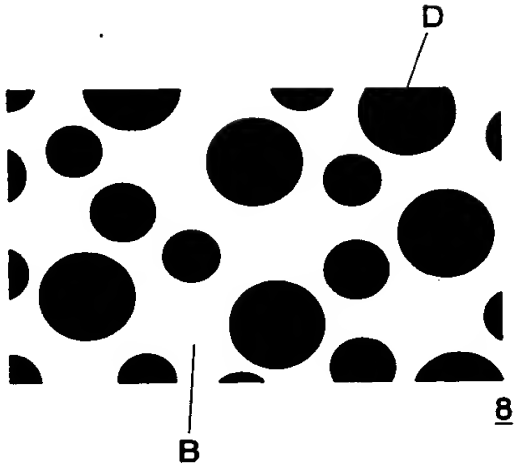

Fig. 5B

Titel: Systeem voor het detecteren van de aanwezigheid van vocht.

De uitvinding heeft betrekking op een systeem voor het detecteren van de aanwezigheid van vocht, voorzien van ten minste een elektronische sensor voor het detecteren van de aanwezigheid van vocht en ten minste een uitlees-inrichting voor het verkrijgen van informatie uit de ten minste ene sensor over de aanwezigheid van vocht.

Een dergelijk systeem is op zich bekend. Bij het bekende systeem is de elektronische sensor veelal voorzien van twee elektrodes waarbij een kortsluiting tussen de elektrodes ten gevolge van de aanwezigheid van vocht door een elektronisch circuit van de sensor wordt gedetecteerd. Met behulp van de uitleesinrichting wordt vervolgens vastgesteld dat in de sensor de genoemde kortsluiting tussen de beide elektrodes optreedt en dat derhalve vocht aanwezig is bij de sensor.

Een nadeel van het bekende systeem is dat de door de sensor gegenereerde informatie over de aanwezigheid van vocht veelal niet voldoende betrouwbaar is. Bovendien is een dergelijke elektronische sensor vrij kostbaar en hierdoor minder geschikt om te worden toegepast als een wegwerpsensor.

De uitvinding heeft onder meer als doel aan de bovengeschetste nadelen tegemoet te komen en voorts nog een aantal voordelen te verschaffen.

Het systeem volgens de uitvinding wordt dienovereenkomstig gekenmerkt in dat de ten minste ene sensor is voorzien van een resonant circuit dat althans voor een gedeelte is gevormd uit een vochtgevoelig materiaal waarvan de elektrische weerstand toeneemt wanneer het materiaal in aanraking komt met vocht en waarbij de uitleesinrichting is voorzien van zender- en ontvangermiddelen voor het genereren van een elektromagnetisch ondervraagveld dat ten minste een frequentiecomponent omvat die overeenkomt met een resonantiefrequentie van het resonante circuit waarbij,

in gebruik, de ten minste ene sensor in het elektromagnetische ondervraagveld wordt gebracht waarbij de uitleesinrichting de responsie van de ten minste ene sensor op het elektromagnetisch ondervraagveld registreert voor het verkrijgen van informatie over de aanwezigheid van vocht bij de ten minste ene sensor.

Het blijkt dat de invloed van vocht op het vochtgevoelige materiaal en daarmee de aanwezigheid van vocht bij de sensor bijzonder gevoelig en nauwkeurig kan worden geregistreerd. Wanneer het vochtgevoelige materiaal in aanraking komt met vocht zal de elektrische weerstand toenemen. Door het toenemen van de elektrische weerstand zullen de elektrische eigenschappen van het resonant circuit veranderen en zal hierbij eveneens de responsie van het resonant circuit op het ondervraagveld veranderen. Hierbij is het zelfs denkbaar dat op deze wijze niet alleen de aanwezigheid van vocht bij de sensor wordt gedetecteerd, maar dat zelfs een indruk kan worden verkregen van de hoeveelheid vocht die bij de sensor aanwezig is.

De sensor volgens de uitvinding kan onder andere worden toegepast in babyluiers, incontinentieluiers, maandverband, matrassen, couveuses, verpakkingen voor groente en fruit, op het wegdek voor detectie van regen en bij een substraat in de glastuinbouw. Ook is het mogelijk de sensor toe te passen in droogprocessen zoals bijvoorbeeld in de papierindustrie.

Bij voorkeur geldt dat het vochtgevoelige materiaal dusdanig in het resonante circuit is opgenomen dat de Q-factor van het resonante circuit afneemt wanneer de weerstand van het vochtgevoelige materiaal toeneemt. De Q-factor van de intacte droge sensor is derhalve hoog. Dit betekent dat de sensor in deze toestand goed kan worden gedetecteerd. Het systeem kan derhalve ook gebruikt worden om te controleren of er in het product (zoals bijvoorbeeld een luier) wel een sensor aanwezig is. Deze mogelijkheid is niet aanwezig bij de hiervoor besproken sensor volgens de

stand van de techniek, omdat deze sensor niet reageert wanneer geen kortsluiting tussen de twee elektrodes aanwezig is.

Een verder voordeel is dat de verandering van de karakteristiek van de sensor reversibel is. Als de sensor weer opdroogt, neemt de weerstand van het vochtgevoelige materiaal weer af.

In de hiervoor geschetste bijzondere uitvoeringsvorm betekent dit dat de Q-factor van het resonante circuit weer toeneemt.

Volgens een bijzondere uitvoeringsvorm geldt dat het resonante circuit ten minste is voorzien van LC-kring. Hierbij kan de gehele LC-kring of ten minste een deel van de LC-kring zijn opgebouwd uit het vochtgevoelige materiaal.

In het bijzonder geldt dat het vochtgevoelige materiaal is voorzien van een in vocht zwelbaar bindmiddel waarin elektrisch geleidende deeltjes zijn opgenomen. Ook is het mogelijk dat het vochtgevoelige materiaal is voorzien van een bindmiddel waarin in vocht zwelbare deeltjes en elektrisch geleidende deeltjes zijn opgenomen. In beide gevallen zorgt vocht voor een zwelling van respectievelijk het bindmiddel en de zwelbare deeltjes. Hierdoor zullen de elektrisch geleidende deeltjes uit elkaar worden getrokken en zal de geleidbaarheid van het vochtgevoelig materiaal afnemen zodat de elektrische weerstand van het materiaal toeneemt.

In het bijzonder geldt dat de uitleesinrichting een alarmsignaal genereert wanneer met behulp van de sensor vocht wordt gedetecteerd.

Volgens een zeer geavanceerde uitvoeringsvorm van de vinding is het systeem eveneens ingericht als een identificatiesysteem waarbij de ten minste ene sensor is voorzien van een met het resonante circuit verbonden actief elektronisch circuit zoals een microprocessor waarin een identificatiecode is opgeslagen, welke identificatiecode

aan het resonante circuit wordt toegevoerd wanneer het resonante circuit door het elektromagnetische ondervraagveld in resonantie wordt gebracht en waarbij de uitleeseenheid is ingericht voor het met behulp van het elektromagnetisch ondervraagveld uitlezen van de identificatiecode.

Dit systeem kan bijvoorbeeld met voordeel in een ziekenhuis worden toegepast waarbij de sensor wordt gebruikt om vocht in een matras van een ziekenhuisbed te registreren. Iedere sensor kan dan worden voorzien van een identificatiecode die bij een bepaald ziekenhuisbed behoort. Op deze wijze is het niet alleen mogelijk om te registreren dat een matras nat is geworden, maar ook welke matras nat is geworden.

Het systeem kan verder nog zijn voorzien van een centrale controle-eenheid die, eventueel draadloos is verbonden met de ten minste ene uitleesinrichting voor het verkrijgen van informatie over van de aanwezigheid van vocht bij de ten minste ene sensor.

In het voorbeeld van het genoemde ziekenhuis kan de centrale controle-eenheid bijvoorbeeld bij een verpleegkundige op een kamer worden opgesteld. De uitleesinrichtingen kunnen in de diverse kamers van de patiënten worden opgesteld. Op deze wijze kan centraal worden geregistreerd in welke kamer, welk bed een nat matras heeft gekregen.

De uitvinding zal thans nader worden toegelicht aan de hand van de tekening. Hierin toont.

Figuur 1 een mogelijke uitvoeringsvorm van een systeem voor het detecteren van de aanwezigheid van vocht volgens de uitvinding;

figuur 2 de overdrachtskarakteristiek van een resonant circuit van een sensor van het systeem volgens figuur 1;

figuur 3 een eerste alternatieve uitvoeringsvorm van een sensor van het systeem volgens figuur 1;

figuur 4a een tweede alternatieve uitvoeringsvorm van de sensor van het systeem volgens figuur 1;

figuur 4b een elektrisch vervangschema van de sensor volgens figuur 4a;

figuur 5a schematisch een relatief droge toestand van het vochtgevoelige materiaal van een van de sensoren volgens de figuren 1, 3, 4a en 4b; en

figuur 5b het vochtgevoelige materiaal van figuur 5a wanneer dit relatief vochtig is.

In figuur 1 is met referentienummer 1 een systeem voor het detecteren van de aanwezigheid van vocht aangeduid. Het systeem is voorzien van een aantal elektronische sensoren 2.i (i = 1, 2, ..., n) voor het detecteren van de aanwezigheid van vocht. Voorts is het systeem voorzien van ten minste één uitleesinrichting 4.1 voor het verkrijgen van informatie vanuit de sensoren 2.i over de aanwezigheid van vocht.

Elk van de sensoren 2.i is voorzien van een gestippeld weergegeven resonant circuit 6 dat althans voor een gedeelte is gevormd van een vochtgevoelig materiaal 8. Het resonante circuit omvat in dit voorbeeld een LC-kring 10, 12 waarin het vochtgevoelige materiaal 8 is opgenomen. Het vochtgevoelige materiaal is van een soort waarvan de elektrische weerstand toeneemt wanneer het materiaal in aanraking komt met vocht.

De uitleesinrichting 4.1 is voorzien van zender- en ontvangermiddelen 14 voor het genereren van een elektromagnetisch ondervraagveld. Het elektromagnetisch ondervraagveld omvat ten minste één frequentiecomponent die overeenkomt met een resonantiefrequentie van het resonante circuit 6. In dit voorbeeld heeft het resonante circuit slechts één resonantiefrequentie f_0. Het elektromagnetische ondervraagveld heeft hierbij eveneens een frequentie f_0. Uitdrukkelijk zij opgemerkt dat het eveneens mogelijk is dat het elektromagnetisch ondervraagveld meer frequenties

omvat bijvoorbeeld omdat het in frequentie kan worden gezwaaid.

De werking van de inrichting is als volgt. Om te controleren of vocht bij de sensor 2.i aanwezig is, wordt met behulp van zender- en ontvangerinrichting 14 het elektromagnetische ondervraagveld met frequentie f_0 uitgezonden. Wanneer de sensor niet vochtig is, betekent dit dat de weerstand van het vochtgevoelige materiaal 8 laag is. Dit betekent weer dat de Q-factor van de LC-kring hoog is. Wanneer het resonante circuit derhalve in het ondervraagveld wordt gebracht, zal het resonante circuit in resonantie geraken en derhalve gaan trillen met de frequentie f_0. Met behulp van de zender- en ontvanger-eenheid 14 wordt geregistreerd dat het resonante circuit 6 in trilling is. De aldus draadloos door de zender- en ontvangerinrichting 14 verkregen informatie over de aanwezigheid van vocht bij sensor 2.i wordt via leiding 16 van de uitleesinrichting 4.1 aan een signaalverwerkings-eenheid 18 van de uitleesinrichting toegevoerd.

De signaalverwerkingseenheid 18 kan bijvoorbeeld zijn voorzien van een drempelcircuit om te bepalen of de responsie van het resonante circuit 6 boven dan wel beneden een bepaalde waarde ligt. Ligt de responsie boven deze bepaalde waarde dan kan worden geconcludeerd dat de sensor droog is en ligt de responsie beneden deze vooraf bepaalde waarde dan kan worden geconcludeerd dat de sensor nat is. In dat geval kan op op zich bekende wijze door de signaalverwerkingseenheid 18 een alarmsignaal worden gegenereerd.

Het vochtgevoelige materiaal 8 kan op verschillende wijzen worden aangebracht. Zo kan de sensor 2.i bijvoor-beeld zijn samengesteld uit een velvormig dragermateriaal 20, waarbij met op zich bekende technieken laagjes geleidend materiaal worden aangebracht die het resonante circuit 6 vormen. In dit voorbeeld is dit resonante circuit onder meer voorzien van een spoel 10 en een condensator 12.

De spoel 10 en de condensator 12 kunnen elk van bijvoorbeeld koper zijn vervaardigd. Het vochtgevoelige materiaal 8 kan als een aparte weerstand op het dragermateriaal 20 zijn aangebracht. Zowel de spoel 10 als de condensator 12 als de vochtgevoelige weerstand 8 zijn in de vorm van sporen aangebracht.

Ook is het mogelijk dat het materiaal van de LC-kring zelf is vervaardigd van vochtgevoelig materiaal. Een dergelijk resonant circuit is getoond in figuur 4a. In figuur 4a is derhalve ten minste een deel van de spoel 10 en/of de condensator 12 van het vochtgevoelige materiaal vervaardigd.

In figuur 4b is het elektrische vervangschema hiervan getoond wat derhalve overeenkomt met het schema van de sensor welke in figuur 1 is getoond.

De realisatie van de vocht afhankelijke geleidbaarheid van het vochtgevoelige materiaal kan bijvoorbeeld worden verkregen door elektrisch geleidende deeltjes D, bij voorkeur zilverhoudend, te mengen met een in water zwelbaar bindmiddel B, zodanig dat de deeltjes D een continu contact maken, dat wil zeggen dat de concentratie van de deeltjes boven de percolatiegrens komt (zie ook figuur 5a). De laagdikte van de aldus gevormde geleidende coating 8 kan in de orde van grootte zijn van wat bijvoorbeeld met zeefdrukken kan worden aangebracht (10-500 μm). Door contact met water zal het bindmiddel B zwellen, waardoor de elektrisch geleidende deeltjes uit elkaar worden gedreven en het continue contact wordt verbroken. Dat wil zeggen, dat de concentratie van de deeltjes D onder de percolatiegrens komt (zie figuur 5b).

In plaats van een in water zwelbaar bindmiddel kan er in combinatie met de elektrisch geleidende deeltjes gebruik worden gemaakt van in water zwelbare deeltjes, terwijl het toegepaste bindmiddel zelf niet in water zwelbaar behoeft te zijn, maar wel in meer of mindere mate voor water gevoelig is. De aard en concentratie van de

zwelbare deeltjes alsook de aard en concentratie van het bindmiddel zijn parameters waarmee de snelheid en mate van de zwelling kunnen worden ingesteld. Hiermee kan een bepaalde karakteristiek van het materiaal ten opzichte van vocht worden verkregen. Twee voorbeelden van recepten voor watergevoelige elektrisch geleidende materialen zijn:

Voorbeeld 1:

Stabileze (0,5% in water)	50
water	10
glycerine (10% in water)	1,25
metalite silver SF 20	2,5
NaOH (10% in water)	0,25

laagdikte nat:	500 µm
laagdikte droog:	100 µm
responstijd:	< 1 s

Voorbeeld 2:

PA 18 polyanhydride resin (40% in MEK)	1,00
Stabileze (geactiveerd in NH_3), deeltjes < 60 µm	0,25
glycerine (20% in butanol)	1,00
metalite silver SF 20	1,50
MEK/butanol (1/1)	2,00

laagdikte nat:	300 µm
laagdikte droog:	170 µm
Responstijd	ca. 45 s

Als geleidende deeltjes kunnen in principe verschillende materiaalsoorten en -vormen worden gekozen. Voorbeelden zijn metalen zoals zilver, koper, rvs, aluminium en zink in vormen als korrels, vezels, flakes,

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

OTTEVANGERS, S., U.
Vereenigde
Nieuwe Parklaan 97
NL-2587 BN The Hague
PAYS-BAS

Date of mailing (day/month/year)
20 February 2001 (20.02.01)

Applicant's or agent's file reference
P10502PC00

IMPORTANT NOTIFICATION

International application No.
PCT/NL99/00562

International filing date (day/month/year)
10 September 1999 (10.09.99)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

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Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[X] the person [X] the name [X] the address [ ] the nationality [ ] the residence

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3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
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003850351

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INTERNATIONAL SEARCH REPORT

In nal Application No
PCT/NL 99/00562

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01N27/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched —

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 40 30 284 A (BRANDES GMBH) 17 June 1992 (1992-06-17) abstract ---	1,19
Y	GB 2 192 059 A (ELECTRICITY COUNCIL) 31 December 1987 (1987-12-31) abstract ---	1,19
A	EP 0 329 436 A (ASAHI CHEMICAL IND) 23 August 1989 (1989-08-23) claims 1-4 ---	1
A	US 3 686 606 A (THOMA PAUL E) 22 August 1972 (1972-08-22) abstract --- -/--	1

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 January 2000	12/01/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Duchatellier, M

Form PCT/ISA/210 (second sheet) (July 1992)

bolletjes etc. Ook materialen als roet, grafiet of intrinsiek geleidende polymeerdeeltjes kunnen in principe worden toegepast.

Door de juiste samenstelling van het vochtgevoelig coating materiaal kan de vochtsensor worden vervaardigd met standaard coating en druktechnieken zoals zeefdrukken, tampondrukken, rollercoaten, spraycoaten etc.

Zoals gezegd kan het vochtgevoelige materiaal 8 dusdanig in het resonante circuit zijn opgenomen dat de Q-factor van het resonante circuit afneemt wanneer de weerstand van het vochtgevoelige materiaal toeneemt.

In figuur 2 is met curve A de overdrachtsfunctie H van het resonante circuit 6 getoond wanneer het vochtgevoelige materiaal droog is, dat wil zeggen wanneer de Q-factor hoog is. Vervolgens is met B de curve aangegeven die wordt verkregen wanneer het vochtgevoelige materiaal nat is met als gevolg dat de Q-factor afneemt.

De zender- en ontvangermiddelen 14 kunnen zijn ingericht als een transmissiesysteem voor het detecteren van een door de sensor 2.i gegeneerd elektromagnetisch responsiesignaal in responsie op het elektromagnetisch ondervraagveld. Indien het resonante circuit door het elektromagnetisch ondervraagveld in trilling wordt gebracht, zal deze immers hierdoor een elektromagnetisch responsiesignaal uitzenden dat weer door de zender- en ontvangermiddelen 14 kan worden gedetecteerd. Men spreekt dan van een op zich bekend transmissiesysteem. De signaalverwerkingsinrichting 18 kan aan de hand van de intensiteit van het gedetecteerde responsiesignaal bepalen in hoeverre de sensor 2.i in contact staat met vocht. Voor de hierboven omschreven sensor, waarvoor geldt dat de Q-factor afneemt wanneer de sensor in contact komt met water kan de signaalverwerkingsinrichting 18 zijn voorzien van een drempelcircuit om te bepalen of de gedetecteerde intensiteit beneden een vooraf bepaalde waarde ligt. Ligt deze inderdaad beneden een vooraf bepaalde waarde dan kan

worden geconcludeerd dat de sensor 2.i nat is en kan desgewenst een alarmsignaal worden afgegeven.

Het is echter eveneens mogelijk dat de zender- en ontvangereenheid zijn ingericht als een op zich bekend absorptiesysteem. Wanneer het resonante circuit 6 door het elektromagnetisch ondervraagveld in trilling wordt gebracht, zal deze energie uit het elektromagnetisch ondervraagveld absorberen. Deze energie-absorptie kan op op zich bekende wijze in de zender- en ontvangerinrichting 14 worden gedetecteerd. Indien de sensor droog is en derhalve een hoge Q-factor heeft, zal veel energie uit het ondervraagveld worden opgenomen. Indien de sensor daarentegen vochtig is, zal weinig of geen energie uit het ondervraagveld worden opgenomen.

Via leiding 16 kan wederom informatie in de vorm van de hoeveelheid opgenomen energie uit het elektromagnetisch ondervraagveld aan de signaalverwerkingsinrichting 18 worden toegevoerd. De uitleesinrichting 41 kan dan aan de hand van de door de ten minste ene sensor geabsorbeerde hoeveelheid energie bepalen in hoeverre de ten minste ene sensor in contact staat met vocht. In het bijzonder geldt wederom dat de signaalverwerkingsinrichting 18 is voorzien van een drempelcircuit om te bepalen of de hoeveelheid opgenomen energie beneden een vooraf bepaalde waarde ligt.

Bij voorkeur geldt dat elke sensor 2.i voorts is voorzien van een actief elektronisch circuit zoals een microprocessor 22 waarin een identificatiecode behorende bij de sensor 2.i is opgeslagen. De microprocessor is verbonden met het resonante circuit 6. Wanneer het resonante circuit zich in het ondervraagveld bevindt, kan een gedeelte van de stromen die in het resonante circuit worden opgewekt, worden gelijkgericht met behulp van bijvoorbeeld een diode 23 en aan de microprocessor 22 worden toegevoerd. In reactie hierop zal de microprocessor de opgeslagen identificatiecodes aan het resonante circuit toevoeren. Het responsiesignaal dat in het resonante

circuit wordt opgewekt in responsie op het elektromagnetisch ondervraagveld wordt dan gemoduleerd met behulp van de identificatiecode. Deze identificatiecode kan door de zender- en ontvangereenheid 14 worden gedetecteerd en aan de signaalverwerkingseenheid 18 worden toegevoerd. De signaalverwerkingseenheid 18 kan dan bepalen van welke sensor 2.i een responsie is gedetecteerd. Een dergelijk systeem is van bijzonder belang wanneer is voorzien, zoals in het onderhavige voorbeeld, van een veelvoud van sensoren 2.i. Wanneer op een gegeven moment de responsie van een of meer sensoren wegvalt, omdat de betreffende sensor in contact komt met vocht, kan met behulp van de uitleesinrichting 4.1 worden vastgesteld welke identificatiecode niet langer wordt ontvangen en derhalve welke sensor in contact staat met vocht.

Een dergelijk systeem kan met voordeel worden toegepast in een ziekenhuis, waarbij elk matras is voorzien van een sensor 2.i. Wanneer een van de matrassen vervolgens vochtig wordt, kan dat met behulp van de uitleesinrichting 4.1 worden gedetecteerd en kan bovendien worden vastgesteld om welke sensor en derhalve om welke matras het gaat. De verpleegkundige kan dan eventueel de patiënt gaan verschonen.

Het systeem kan verder worden uitgebreid met een centrale controle-eenheid 24 en een aantal uitleesinrichtingen 4.i (i = 1, 2, ..., m). Elke uitleesinrichting 4.i is eventueel draadloos verbonden met de centrale controle-eenheid 24, voor het verkrijgen van informatie over de aanwezigheid van vocht bij een van de sensoren 2.i. In gebruik kan bijvoorbeeld in elke kamer van een ziekenhuis een uitleesinrichting 4.i worden opgesteld. Voorts zijn in elke kamer een aantal bedden met matrassen opgesteld waarbij elk der matrassen is voorzien van een sensor 2.i met een unieke identificatiecode. Indien een van de matrassen in de kamers vochtig wordt, dan kan aldus bij de centrale controle-eenheid 24 een alarmsignaal worden

gegenereerd waarbij een verpleegkundige direct kan nagaan welke sensor in welk matras in aanraking is gekomen met vocht.

De uitvinding is geenszins beperkt tot de hiervoor geschetste uitvoeringsvormen. Zo kan het vochtgevoelige materiaal 8 eveneens dusdanig in het resonante circuit zijn opgenomen dat de Q-factor van het resonante circuit toeneemt wanneer de weerstand van het vochtgevoelige materiaal toeneemt. Een voorbeeld hiervan is getoond in figuur 3. Het vochtgevoelige materiaal 8 is hierbij in de vorm van een weerstand parallel geschakeld aan het LC-circuit 10, 12. Wanneer de sensor volgens figuur 3 droog is, zal de weerstand van het vochtgevoelige materiaal 8 klein zijn en hiermee in feite kortsluiting veroorzaken in de LC-kring 10, 12. Dit betekent dat de sensor volgens figuur 3 niet of nauwelijks zal reageren op het ondervraagveld wanneer de sensor droog is. Wanneer de sensor daarentegen in aanraking komt met vocht zal de weerstand van het vochtgevoelig materiaal toenemen en de kortsluiting geleidelijk worden opgeheven. Dit heeft tot gevolg dat de LC-kring in dat geval wel zal reageren wanneer deze in het genoemde ondervraagveld wordt gebracht. Deze reactie kan dan weer met behulp van de uitleesinrichting worden gedetecteerd, zowel wanneer de uitleesinrichting is ingericht als een transmissiesysteem als een absorptiesysteem. Wanneer derhalve een elektromagnetisch responsiesignaal wordt ontvangen, wanneer wordt gedetecteerd dat energie uit het elektrisch ondervraagveld wordt opgenomen, kan worden geconcludeerd dat de desbetreffende sensor nat is.

In het voorbeeld van figuur 3 is de sensor wederom voorzien van de eerder besproken microprocessor. Wanneer de sensor van figuur 3 reageert, kan dan tevens direct de identificatiecode naar de zender- en ontvangerinrichting worden gezonden, zodat met behulp van de uitleesinrichting direct kan worden vastgesteld welke sensor reageert, met

andere woorden welke sensor nat is. De overdracht van het resonante circuit volgens figuur 3 is derhalve dusdanig dat curve A van figuur 2 van toepassing is wanneer de sensor nat is en curve B wanneer de sensor droog is. Ook is het denkbaar dat elke sensor 2.i is voorzien van een resonant circuit met een unieke resonantie frequent f_i, waarbij $f_i \neq t_j$ indien $i \neq j$. Door nu een ondervraagveld uit te zenden waarvan de frequentie op vooraf bekende wijze oploopt, kan worden gedetecteerd of een senor 2.i vochtig is waarbij tevens de frequentie f_i en daarmee de identiteit van een sensor kan worden vastgesteld.

Voorts is het nog denkbaar dat andere principes worden toegepast waardoor de elektrische weerstand van het materiaal van de LC-kring is veranderd. Als voorbeeld kan worden genoemd dat de elektrische weerstand van de intrinsiek geleidende polymeren, zoals polyaniline, polypyrrool of polythiofeen verandert onder invloed van water waarin zouten of ionen zijn opgenomen. In dat geval kan, in het bijzonder, bijvoorbeeld urine worden gedetecteerd. Uitdrukkelijk wordt vermeld dat in elk van de uitvoeringsvormen de microprocessor kan worden weggelaten.

Dergelijke varianten worden elk binnen het kader van de uitvinding te vallen.

CONCLUSIES

1. Systeem voor het detecteren van de aanwezigheid van vocht, voorzien van ten minste een elektronische sensor voor het detecteren van de aanwezigheid van vocht en ten minste een uitleesinrichting voor het verkrijgen van informatie uit de ten minste ene sensor over de aanwezigheid van vocht, met het kenmerk, dat de ten minste ene sensor is voorzien van een resonant circuit dat althans voor een gedeelte is gevormd van een vochtgevoelig materiaal waarvan de elektrische weerstand toeneemt wanneer het materiaal in aanraking komt met vocht en waarbij de uitleesinrichting is voorzien van zender- en ontvanger-middelen voor het genereren van een elektromagnetisch ondervraagveld dat ten minste een frequentiecomponent omvat die overeenkomt met een resonantiefrequentie van het resonante circuit waarbij, in gebruik, de ten minste ene sensor in het elektromagnetische ondervraagveld wordt gebracht waarbij de uitleesinrichting de responsie van de ten minste ene sensor op het elektromagnetisch ondervraagveld registreert voor het verkrijgen van informatie over de aanwezigheid van vocht bij de ten minste ene sensor.

2. Systeem volgens conclusie 1, met het kenmerk, dat het vochtgevoelig materiaal dusdanig in het resonante circuit is opgenomen dat de Q-factor van het resonante circuit afneemt wanneer de weerstand van het vochtgevoelige materiaal toeneemt.

3. Systeem volgens conclusie 1, met het kenmerk, dat het vochtgevoelig materiaal dusdanig in het resonante circuit is opgenomen dat de Q-factor van het resonante circuit toeneemt wanneer de weerstand van het vocht-gevoelige materiaal toeneemt.

4. Systeem volgens een der voorgaande conclusies, met het kenmerk, dat het resonante circuit ten minste is voorzien van een LC-kring.

5. Systeem volgens conclusie 4, met het kenmerk, dat de gehele LC-kring of tenminste een deel van de LC-kring is opgebouwd uit het vochtgevoelige materiaal.

6. Systeem volgens een der voorgaande conclusies, met het kenmerk, dat het vochtgevoelige materiaal is voorzien van een in vocht zwelbaar bindmiddel waarin elektrische geleidende deeltjes zijn opgenomen.

7. Systeem volgens een der voorgaande conclusies, met het kenmerk, dat het vochtgevoelige materiaal is voorzien van een bindmiddel waarin in vocht zwelbare deeltjes en elektrisch geleidende deeltjes zijn opgenomen.

8. Systeem volgens een der voorgaande conclusies, met het kenmerk, dat het vochtgevoelige materiaal in de vorm van een coating op een dragermateriaal is aangebracht.

9. Systeem volgens conclusies 4 en 8, met het kenmerk, dat althans een gedeelte van de LC-kring wordt gevormd door de coating.

10. Systeem volgens een der voorgaande conclusies, met het kenmerk, dat de zender- en ontvangermiddelen zijn ingericht als een transmissiesysteem voor het detecteren van een door de ten minste ene sensor gegenereerd elektromagnetisch responsiesignaal in responsie op het elektromagnetisch ondervraagveld.

11. Systeem volgens conclusie 10, met het kenmerk, dat, in gebruik, de uitleesinrichting aan de hand van de intensiteit van het gedetecteerde responsiesignaal bepaalt in hoeverre de ten minste ene sensor in contact staat met vocht.

12. Systeem volgens conclusies 2 en 11, met het kenmerk, dat de uitleesinrichting is voorzien van een drempelcicuit om te bepalen of de gedetecteerde intensiteit beneden een vooraf bepaalde waarde ligt.

13. Systeem volgens een der conclusies 1-9, met het kenmerk, dat de zender- en ontvangermiddelen zijn ingericht als een absorptiesysteem voor het detecteren van energie die door de ten minste ene sensor in responsie op het elektromagnetische ondervraagveld uit het ondervraagveld is opgenomen.

14. Systeem volgens conclusies 13, met het kenmerk, dat in gebruik, de uitleesinrichting aan de hand van de door de ten minste ene sensor geabsorbeerde hoeveelheid energie bepaalt in hoeverre de ten minste ene sensor in contact staat met vocht.

15. Systeem volgens conclusies 2 en 13, met het kenmerk, dat de uitleesinrichting is voorzien van een drempelcircuit om te bepalen of de hoeveelheid opgenomen energie beneden een vooraf bepaalde waarde ligt.

16. Systeem volgens een der voorgaande conclusies, met het kenmerk, dat de uitleesinrichting een alarmsignaal genereert wanneer met behulp van de ten minste ene sensor vocht wordt gedetecteerd.

17. Systeem volgens een der voorgaande conclusies, met het kenmerk, dat het systeem eveneens is ingericht als een identificatiesysteem waarbij de ten minste ene sensor is voorzien van een met het resonante circuit verbonden microprocessor waarin een identificatiecode is opgeslagen welke identificatiecode aan het resonante circuit wordt toegevoerd wanneer het resonante circuit door het elektromagnetische ondervraagveld in resonantie wordt gebracht en waarbij de uitleeseenheid is ingericht voor het met behulp van het elektromagnetisch ondervraagveld uitlezen van de identificatiecode.

18. Systeem volgens een der voorgaande conclusies, met het kenmerk, dat het systeem verder is voorzien van een centrale controle-eenheid die, eventueel draadloos, is verbonden met de ten minste ene uitleesinrichting voor het verkrijgen van informatie over van de aanwezigheid van vocht bij de ten minste ene sensor.

19. Sensor van het systeem volgens een der voorgaande conclusies.

UITTREKSEL

Het systeem is voorzien van ten minste een elektronische sensor voor het detecteren van de aanwezigheid van vocht. Voorts omvat het systeem ten minste een uitleesinrichting voor het verkrijgen van informatie uit de sensor over de aanwezigheid van vocht. De sensor is voorzien van een resonant circuit dat althans voor een gedeelte is gevormd uit een vochtgevoelig materiaal waarvan de elektrische weerstand toeneemt wanneer het materiaal in aanraking komt met vocht. De uitleesinrichting is voorzien van zender- en ontvangermiddelen voor het genereren van een elektromagnetisch ondervraagveld.

PATENT COOPERATION TREATY

REC'D 17 JAN 2001
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PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
P10502PC00		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NL99/00562	10/09/1999	11/09/1998
International Patent Classification (IPC) or national classification and IPC G01N27/12		
Applicant NEDERLANDSE ORGANISATIE VOOR TOEGEPAST-NA...et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 9 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
10/04/2000	09. 01. 01
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Van der Goot, D Telephone No. +49 89 2399 2562

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NL99/00562

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

5-12	as originally filed			
1-3,4A-4B	as received on	05/12/2000	with letter of	04/12/2000

Claims, No.:

1-19	as received on	05/12/2000	with letter of	04/12/2000

Drawings, sheets:

1/3-3/3	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-19
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-19
Industrial applicability (IA)	Yes:	Claims	1-19
	No:	Claims	

2. Citations and explanations
   see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

Section V

1. Reference is made to the following documents:

   D1: DE 40 30 284 A (BRANDES GMBH) 17 June 1992 (1992-06-17)
   D2: EP-A-0 329 436 (ASAHI CHEMICAL IND) 23 August 1989 (1989-08-23)
   D3: GB-A-2 192 059 (ELECTRICITY COUNCIL) 31 December 1987 (1987-12-31)

2. **Novelty (Art. 33(2), PCT) and Inventive Step (Article 33(3), PCT)**

2.1 Document D1, particularly the figures 1 to 3 in conjunction with their description, is considered to represent the most relevant state of the art. The document discloses (the references in parentheses applying to this document) :
A system for detecting the presence of moisture (Figures 1 and 2), comprising at least one electronic sensor (MS) for detecting the presence of moisture and at least one reading device (ME) for obtaining information from the at least one sensor about the presence of moisture, wherein
a) the at least one sensor comprises a resonant circuit (column 2, lines 4-10) which is at least partly formed from a moisture sensitive material (FS), the electrical resistance of which changes when the material comes into contact with moisture (column 1, lines 62-65);
b) the reading device comprises means (W1,W2) for generating an electromagnetic interrogation field comprising at least one frequency component corresponding to a resonance frequency of the resonant circuit and for recording the response of the at least one electronic sensor to the electromagnetic interrogation field to obtain information about the presence of moisture at the at least one sensor (see Fig. 2 and column 3, lines 3- 10).

The system of claim 1 of the present application differs from and therefore is novel (Article 33(2) PCT) over the disclosure of D1 in that :
a) the electrical resistance of the moisture sensitive material increases when the material comes into contact with moisture, and
b) the reading device comprises transmitter-receiver means for wirelessly generating the electromagnetic interrogation field and for wirelessly

recording the response of the at least one electronic sensor to the electromagnetic interrogation field to obtain information about the presence of moisture at the at least one electronic sensor if the at least one electronic sensor is brought into the electromagnetic interrogation field.

The features a) and b) can be applied independently from each other.
As to feature a), there is no convincing evidence, nor any reason to believe that a material, the electrical resistance of which increases when it comes into contact with moisture, would be more suitable in combination with feature b) than a material of which the electrical resistance decreases when it comes into contact with moisture, as is the case in document D1. Therefore, these alternatives are fully equivalent and taking one rather than the other does not involve an inventive step.
As to feature b) it is known in the field of moisture detection, to wirelessly record the response of a sensing device, which is sensitive to moisture by changing in resistance, thereby controlling the signal transmitted from an aerial by affecting the Q factor (see D3, page 1, lines 86-101). The sensing device is part of a **tuned circuit** including the aerial and is brought into an electromagnetic interrogation field produced by a sparking device (see D3, page 1, lines 73-85). So the only difference between feature b) and the disclosure of D3 is, that the electromagnetic interrogation field is provided by a transmitter-receiver means, whereas in D3 the transmitter (the sparking device) and the receiver are separated from each other. This difference does not render the feature b) inventive over the disclosure of D3. The use of a transmitter-receiver means for the stated purpose is considered to fall within the competence of the person skilled in the art and may be selected by him in accordance with circumstances without the exercise of inventive skill. Consequently the subject matter of claim 1 lacks an inventive step over the combined disclosures of D1 and D3 and the general knowledge of the person skilled in the art of wireless transmission/receiving techniques.
The subject matter of claim 1, therefore, lacks an inventive step and the claim, although novel (Art. 33(2), PCT), does not meet the requirements of Article 33(3), PCT.

2.2 Dependent claims 2-19 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in

respect of inventive step, the reasons being as follows:

The additional features of claims 2 to 5 are known or directly derivable from D1 (as to claims 2 and 3 see figure 2 in conjunction with its description and as to claims 4 and 5, see figure 1 of D1).
As to the additional features of claims 6 to 8 reference is made to D2, which for use in a moisture sensor discloses a material the resistance of which increases if it becomes wet (see in particular D2, page 5, lines 20-24; the passage linking pages 5 and 6; and page 6, lines 51-63).
As to claim 9, it would be obvious to use a moisture sensitive material known from D2 in a system disclosed in D1.
As to claims 10 to 12 reference is made to D1, column 2, lines 8-10 ; figure 2, the curve K1 and the threshold Us.
As to claims 13-15, designing the transmitter-receiver means as an absorption system is known per se as already indicated at page 9, lines 12-14 of the application. This alternative to the transmission system of claims 10-12 may be selected by the skilled person in accordance with circumstances without any inventive effort.
The provision of an alarm as in claim 16 is a mere design feature which may be selected by the skilled person in accordance with circumstances without the exercise of inventive skill (see e.g. D2, page 11, lines 1-3).
As to claim 17, reference is made to the identification system described in column 1, line 64 to column 2, line 3 and column 3, lines 11-33 of D1.
As to claim 18 reference is made to the central control unit (Z) shown in figure 3 of D1.
In view of the above, a sensor according to claim 19 is not inventive over the disclosure of D1.

Likewise claims 2-19 do not satisfy the requirements of Article 33(3), PCT.

Section VII

1. It is questionable whether the shortcomings of the prior discussed in the original application also apply to the prior art in D1-D3 introduced after the filing. The

discussion of the latter prior art, therefore, should be purely factual.

2. Reference numeral "1" (see page 4, line 31 of the application) is not shown in the drawings.

3. Lines 35-36 on page 4 of the original application should be inserted at the end of page 4B.

05. 12. 2000

(65)

Title: A system for detecting the presence of moisture.

The invention relates to a system for detecting the presence of moisture, comprising at least one electronic sensor for detecting the presence of moisture and at least one reading device for obtaining information from the at least one sensor about the presence of moisture, wherein the at least one sensor comprises a resonant circuit which is at least partly formed from a moisture sensitive material, the electrical resistance of which changes when the material comes into contact with moisture, the reading device comprises means for generating an electromagnetic interrogation field comprising at least one frequency component corresponding to a resonance frequency of the resonant circuit and for recording the response of the at least one sensor to the electromagnetic interrogation field to obtain information about the presence of moisture at the at least one sensor.

Such a system is known from DE 40 30 284. In the known system the reading device is provided with a measuring circuit comprising a transformer connected to the resonance circuit. The resonant circuit comprises a material from which the electrical resistance increases when the material comes into contact with moisture.

It is a drawback of the known system that the information generated by the sensor about the presence of moisture is often not sufficiently reliable. Moreover, such a system is rather expensive and thus less suitable for use as a disposable sensor, because the reading device and the sensor are part of one and the same device. Furthermore the system is not suitable for wirelessly obtaining information about the presence of moisture.

The invention has for its object, inter alia, to meet the above drawbacks and, furthermore, to provide a number of advantages.

The system according to the invention is accordingly characterized in that the electrical resistance of the material (18)

increases when the material comes in to contact with moisture and the reading device (4.1) comprising transmitter-receiver means (14) for wirelessly generating the electromagnetic interrogation field and for wirelessly recording the response of the at least one sensor (2.i) to the electromagnetic interrogation field to obtain the information about the presence of moisture at the at least one sensor (2.i). if the at least one sensor (2.i) is wirelessly brought into the electromagnetic interrogation field.

It has been found that the effect of moisture on the moisture sensitive material and thus the presence of moisture at the sensor can be recorded very sensitively and accurately. When the moisture sensitive material comes into contact with moisture, the electrical resistance will increase. Because of the increase in the electrical resistance, the electrical properties of the resonant circuit will change and the response of the resonant circuit to the interrogation field will thereby also change. In this connection it is even conceivable that in this manner not only the presence of moisture at the sensor is detected, but that even an impression can be obtained of the amount of moisture present at the sensor.

The sensor according to the invention can be used, inter alia, in baby diapers, incontinence diapers, sanitary towels, incubators, packages for vegetables and fruit, on the road surface for detection of rain and at a substratum in the cultivation under glass. It is also possible to use the sensor in drying processes, such as, for instance, in the paper industry.

GB 21 92 059 discloses a system comprising a wetness sensor for wirelessly reading the wetness sensor. The system is for measuring the moisture content of oil in a container. The wetness sensor comprises a moisture detector, an active transmitter and an antenna for generating a modulation of the transmission signal according to the resistance of the moisture detector by changing the q-factor of the antenna. In this known system energy is supplied to the sensor by means of mechanical vibration submitted to an outerwall of the container comprising the sensor.

EP-A-0 329 436 discloses a moisture and dew detection sensor comprising a fabric and a moisture sensing resistive substance adhered in a substantially continued and dispersed state to the fabric.

The resistance of the fabric increases if it comes into contact with moisture. Furthermore the resistance of the fabric is measured by a non-wireless connection to a measuring unit . The system is however not provided with a reading unit which generates an interrogation field with a frequency which corresponds with a resonance frequency of a resonance circuit of the sensor so that the resonance circuit is brought in resonance by means of the interrogation field.

Preferably, it applies that the moisture sensitive material is included in the resonant circuit in such a manner that the Q factor of the resonant circuit decreases when the resistance of the moisture sensitive material increases. The Q factor of the intact dry sensor is therefore high. This means that the sensor can be properly detected in this condition. The system can therefore also be used to check whether a sensor is present in the product (such as, for instance, a diaper). This possibility is not present at the above prior art sensor, because this sensor does not react when no short circuit is present between the two electrodes.

A further advantage is that the change in the characteristic of the sensor is reversible. When the sensor dries again, the resistance of the moisture sensitive material will decrease.

In the above special embodiment this means that the Q factor of the resonant circuit increases again.

According to a special embodiment it applies that the resonant circuit at least comprises an LC circuit. In this connection the entire LC circuit or at least part of the LC circuit may be built up from the moisture sensitive material.

In particular, it applies that the moisture sensitive material comprises a binding agent capable of swelling in moisture, in which

binding ag nt electrically conductive particles are included. It is also possible that the moisture sensitive material comprises a binding agent in which particles capable of swelling in moisture and electrically conductive particles are included. In both cases moisture ensures a swelling of respectively the binding agent and the particles capable of swelling. Consequently, the electrically conductive particles will be drawn apart and the conductivity of the moisture sensitive material will decrease so that the electrical resistance of the material increases.

In particular, it applies that the reading device generates an alarm signal when moisture is detected by means of the sensor.

According to a very advanced embodiment of the invention the system is also designed as an identification system in which the at least one sensor comprises an active electronic circuit connected with the resonant circuit, such as a microprocessor in which an identification code is stored, which identification code is passed to the resonant circuit when the resonant circuit is resonated by the electromagnetic interrogation field, and the reading device being arranged to read the identification code by means of the electromagnetic interrogation field.

This system can, for instance, advantageously be used in a hospital, the sensor being used to record moisture in a mattress of a hospital bed. Each sensor may then comprise an identification code belonging to a specific hospital bed. In this manner it is not only possible to record that a mattress has become wet, but also which mattress has become wet.

The system may further comprise a central control unit which is, optionally wirelessly, connected with the at least one reading device for obtaining information about the presence of moisture at the at least one sensor.

In the example of the above hospital the central control unit can be installed, for instance, in the room of a nurse. The reading devices can

be installed in the different rooms of the patients. In this manner it can be centrally recorded in which room which bed has got a wet mattress.

The invention will now be explained in more detail with reference to the drawing, in which:

Fig. 1 shows a possible embodiment of a system for detecting the presence of moisture according to the invention;

Fig. 2 shows the transfer characteristic of a resonant circuit of a sensor of the system of Fig. 1;

Fig. 3 shows a first alternative embodiment of a sensor of the system of Fig. 1;

Fig. 4a shows a second alternative embodiment of a sensor of the system of Fig. 1;

Fig. 4b shows an electrical equivalent circuit diagram of the sensor of Fig. 4a;

Fig. 5a diagrammatically shows a relatively dry condition of the moisture sensitive material of one of the sensors of Figs. 1, 3, 4a and 4b; and

Fig. 5b shows the moisture sensitive material of Fig. 5a, when this is relatively moist.

In Fig. 1 a system for detecting the presence of moisture is indicated by reference numeral 1. The system comprises a number of electronic sensors 2.i (i = 1, 2, ..., n) for detecting the presence of moisture. The system further comprises at least one reading device 4.1 for obtaining

The text continues on page 5 of the original text.

NEW CLAIMS (65)

1. A system (1) for detecting the presence of moisture, comprising at least one electronic sensor (2.i) for detecting the presence of moisture and at least one reading device (4.1) for obtaining information from the at least one sensor about the presence of moisture, wherein the at least one sensor (2.i) comprises a resonant circuit (6) which is at least partly formed from a moisture sensitive material (8), the electrical resistance of which changes when the material (8) comes into contact with moisture, the reading device (4.1) comprises means (14) for generating an electromagnetic interrogation field comprising at least one frequency component corresponding to a resonance frequency of the resonant circuit (6) and for recording the response of the at least one sensor (2.i) to the electromagnetic interrogation field to obtain information about the presence of moisture at the at least one sensor, characterized in that, the electrical resistance of the material (18) increases when the material comes in to contact with moisture and the reading device (4.1) comprising transmitter-receiver means (14) for wirelessly generating the electromagnetic interrogation field and for wirelessly recording the response of the at least one sensor (2.i) to the electromagnetic interrogation field to obtain the information about the presence of moisture at the at least one sensor (2.i). if the at least one sensor (2.i) is wirelessly brought into the electromagnetic interrogation field

2. A system according to claim 1, characterized in that the moisture sensitive material (8) is included in the resonant circuit (6) in such a manner that the Q factor of the resonant circuit (6) decreases when the resistance of the moisture sensitive material (8) increases.

3. A system according to claim 1, characterized in that the moisture sensitive material (8) is included in the resonant circuit (6) in

such a manner that the Q factor of the resonant circuit (6) increases when the resistance of the moisture sensitive material (8) increases.

4. A system according to any of the preceding claims, characterized in that the resonant circuit at (6) least comprises an LC circuit (10,12).

5. A system according to claim 4, characterized in that the entire LC circuit (10,12) or at least part of the LC circuit (10,12) is built up from the moisture sensitive material (8).

6. A system according to any of the preceding claims, characterized in that the moisture sensitive material (8) comprises a binding agent capable of swelling in moisture, in which binding agent electrically conductive particles are included.

7. A system according to any of the preceding claims, characterized in that the moisture sensitive material (8) comprises a binding agent in which particles capable of swelling in moisture and electrically conductive particles are included.

8. A system according to any of the preceding claims, characterized in that the moisture sensitive material (8) is arranged on a carrier material in the form of a coating.

9. A system according to claims 4 and 8, characterized in that at least part of the LC circuit (10,12) is formed by the coating.

10. A system according to any of the preceding claims, characterized in that the transmitter-receiver means (14) are designed as a transmission system for detecting an electromagnetic response signal generated by the at least one sensor (2.i), in response to the electromagnetic interrogation field.

11. A system according to claim 10, characterized in that, in use, the reading device (4.1) determines on the basis of the intensity of the detected response signal to what extent the at least one sensor (2.i) is in contact with moisture.

12. A system according to claims 2 and 11, characterized in that the reading device (4.1) comprises a threshold circuit to determine whether the detected intensity is below a predetermined value.

13. A system according to any of claims 1-9, characterized in that the transmitter-receiver means (14) are designed as an absorption system for detecting energy taken up from the interrogation field by the at least one sensor (2.i) in response to the electromagnetic interrogation field.

14. A system according to claim 13, characterized in that, in use, the reading device (4.1) determines on the basis of the amount of energy absorbed by the at least one sensor (2.i) to what extent the at least one sensor (2.i) is in contact with moisture.

15. A system according to claims 2 and 13, characterized in that the reading device (4.1) comprises a threshold circuit (18) to determine whether the amount of energy absorbed is below a predetermined value.

16. A system according to any of the preceding claims, characterized in that the reading device (4.1) generates an alarm signal when moisture is detected by means of the at least one sensor.

17. A system according to any of the preceding claims, characterized in that the system (1) is also designed as an identification system in which the at least one sensor (2.i) comprises a microprocessor (22) connected with the resonant circuit (6), in which microprocessor (22) an identification code is stored, which identification code is passed to the resonant circuit (6) when the resonant circuit (6) is resonated by the electromagnetic interrogation field, and the reading device (4.1) being arranged to read the identification code by means of the electromagnetic interrogation field.

18. A system according to any of the preceding claims, characterized in that the system further comprises a central control unit (24) which is, optionally wirelessly, connected with the at least one reading device (4.1)

for obtaining information about the presence of moisture at the at least one sensor (2.i).

19. A sensor (2.i) of the system according to any of the preceding claims.

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

Ir A.W.PRINS c.s.
VEREENIGDE
Nieuwe Parklaan 97
NL-2587 BN The Hague
PAYS-BAS

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing *(day/month/year)*	09. 01. 01
Applicant's or agent's file reference P10502PC00	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NL99/00562	10/09/1999	11/09/1998

Applicant
NEDERLANDSE ORGANISATIE VOOR TOEGEPAST-NA...et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Conner, M Tel.+49 89 2399-2241

Form PCT/IPEA/416 (July 1992)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
P10502PC00		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NL99/00562	10/09/1999	11/09/1998
International Patent Classification (IPC) or national classification and IPC G01N27/12		
Applicant NEDERLANDSE ORGANISATIE VOOR TOEGEPAST-NA...et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 9 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
10/04/2000	09. 01. 01
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Van der Goot, D Telephone No. +49 89 2399 2562

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NL99/00562

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

5-12	as originally filed			
1-3,4A-4B	as received on	05/12/2000	with letter of	04/12/2000

Claims, No.:

1-19	as received on	05/12/2000	with letter of	04/12/2000

Drawings, sheets:

1/3-3/3	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-19
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-19
Industrial applicability (IA)	Yes:	Claims	1-19
	No:	Claims	

2. Citations and explanations
   see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

Section V

1. Reference is made to the following documents:

   D1: DE 40 30 284 A (BRANDES GMBH) 17 June 1992 (1992-06-17)
   D2: EP-A-0 329 436 (ASAHI CHEMICAL IND) 23 August 1989 (1989-08-23)
   D3: GB-A-2 192 059 (ELECTRICITY COUNCIL) 31 December 1987 (1987-12-31)

2. **Novelty (Art. 33(2), PCT) and Inventive Step (Article 33(3), PCT)**

2.1 Document D1, particularly the figures 1 to 3 in conjunction with their description, is considered to represent the most relevant state of the art. The document discloses (the references in parentheses applying to this document) :
A system for detecting the presence of moisture (Figures 1 and 2), comprising at least one electronic sensor (MS) for detecting the presence of moisture and at least one reading device (ME) for obtaining information from the at least one sensor about the presence of moisture, wherein
a) the at least one sensor comprises a resonant circuit (column 2, lines 4-10) which is at least partly formed from a moisture sensitive material (FS), the electrical resistance of which changes when the material comes into contact with moisture (column 1, lines 62-65);
b) the reading device comprises means (W1,W2) for generating an electromagnetic interrogation field comprising at least one frequency component corresponding to a resonance frequency of the resonant circuit and for recording the response of the at least one electronic sensor to the electromagnetic interrogation field to obtain information about the presence of moisture at the at least one sensor (see Fig. 2 and column 3, lines 3- 10).

The system of claim 1 of the present application differs from and therefore is novel (Article 33(2) PCT) over the disclosure of D1 in that :
a) the electrical resistance of the moisture sensitive material increases when the material comes into contact with moisture, and
b) the reading device comprises transmitter-receiver means for wirelessly generating the electromagnetic interrogation field and for wirelessly

recording the response of the at least one electronic sensor to the electromagnetic interrogation field to obtain information about the presence of moisture at the at least one electronic sensor if the at least one electronic sensor is brought into the electromagnetic interrogation field.

The features a) and b) can be applied independently from each other.
As to feature a), there is no convincing evidence, nor any reason to believe that a material, the electrical resistance of which increases when it comes into contact with moisture, would be more suitable in combination with feature b) than a material of which the electrical resistance decreases when it comes into contact with moisture, as is the case in document D1. Therefore, these alternatives are fully equivalent and taking one rather than the other does not involve an inventive step.
As to feature b) it is known in the field of moisture detection, to wirelessly record the response of a sensing device, which is sensitive to moisture by changing in resistance, thereby controlling the signal transmitted from an aerial by affecting the Q factor (see D3, page 1, lines 86-101). The sensing device is part of a **tun d circuit** including the aerial and is brought into an electromagnetic interrogation field produced by a sparking device (see D3, page 1, lines 73-85). So the only difference between feature b) and the disclosure of D3 is, that the electromagnetic interrogation field is provided by a transmitter-receiver means, whereas in D3 the transmitter (the sparking device) and the receiver are separated from each other. This difference does not render the feature b) inventive over the disclosure of D3. The use of a transmitter-receiver means for the stated purpose is considered to fall within the competence of the person skilled in the art and may be selected by him in accordance with circumstances without the exercise of inventive skill. Consequently the subject matter of claim 1 lacks an inventive step over the combined disclosures of D1 and D3 and the general knowledge of the person skilled in the art of wireless transmission/receiving techniques.
The subject matter of claim 1, therefore, lacks an inventive step and the claim, although novel (Art. 33(2), PCT), does not meet the requirements of Article 33(3), PCT.

2.2 Dependent claims 2-19 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in

respect of inventive step, the reasons being as follows:

The additional features of claims 2 to 5 are known or directly derivable from D1 (as to claims 2 and 3 see figure 2 in conjunction with its description and as to claims 4 and 5, see figure 1 of D1).
As to the additional features of claims 6 to 8 reference is made to D2, which for use in a moisture sensor discloses a material the resistance of which increases if it becomes wet (see in particular D2, page 5, lines 20-24; the passage linking pages 5 and 6; and page 6, lines 51-63).
As to claim 9, it would be obvious to use a moisture sensitive material known from D2 in a system disclosed in D1.
As to claims 10 to 12 reference is made to D1, column 2, lines 8-10 ; figure 2, the curve K1 and the threshold Us.
As to claims 13-15, designing the transmitter-receiver means as an absorption system is known per se as already indicated at page 9, lines 12-14 of the application. This alternative to the transmission system of claims 10-12 may be selected by the skilled person in accordance with circumstances without any inventive effort.
The provision of an alarm as in claim 16 is a mere design feature which may be selected by the skilled person in accordance with circumstances without the exercise of inventive skill (see e.g. D2, page 11, lines 1-3).
As to claim 17, reference is made to the identification system described in column 1, line 64 to column 2, line 3 and column 3, lines 11-33 of D1.
As to claim 18 reference is made to the central control unit (Z) shown in figure 3 of D1.
In view of the above, a sensor according to claim 19 is not inventive over the disclosure of D1.

Likewise claims 2-19 do not satisfy the requirements of Article 33(3), PCT.

Section VII

1. It is questionable whether the shortcomings of the prior discussed in the original application also apply to the prior art in D1-D3 introduced after the filing. The

discussion of the latter prior art, therefore, should be purely factual.

2. Reference numeral "1" (see page 4, line 31 of the application) is not shown in the drawings.

3. Lines 35-36 on page 4 of the original application should be inserted at the end of page 4B.